TRANSACTIONS
OF THE
ROYAL SOCIETY OF NEW ZEALAND

BOTANY

VOL. 1 NO. 20 JULY 27, 1962
[Continued from *Transactions of the Royal Society of N.Z.*, Volume 88, Part 4.]

The Genus Exobasidium in New Zealand

By R. F. R. McNABB,
Plant Diseases Division, Department of Scientific and Industrial Research, Auckland

[*Received by the Editor, September 11, 1961.*]

Abstract

EIGHT species of *Exobasidium* are described and illustrated, including four new species and one new combination. The four new species all occur on members of the Epacridaceae. A key to the species is given.

THE genus *Exobasidium* contains some 75 described species, but it is doubtful whether half of these are valid. All are parasitic on stems, leaves or flowers of woody Dicotyledons.

The taxonomic position of the genus is controversial, but most authorities now place it in the Exobasidiaceae. The disposition of this family within the Basidiomycetes varies according to the accepted limits of the Heterobasidiomycetes and Homobasidiomycetes. Talbot (1954) would include it in the former because of its resemblance to the Ustilaginales, while Savile (1955) and Martin (1961) place it in the latter. Viennot-Bourgin (1949) and Martin (1961) place the family in a separate order, the Exobasidiales, because of its primitive nature. Graafland (1960) discusses the relationship between *Exobasidium, Ustilago, Tilletia* and *Taphrina,* but makes no comment on its possible taxonomic position. Of the genera assigned to this family, it is probable that only three should be retained—viz., *Exobasidium* Wor., *Kordyana* Rac. em. Gäum. parasitic on the Commelinaceae, and *Arcticomyces* Savile, on the Saxifragaceae.

The intrageneric taxonomy is confused and many species are inaccurately and inadequately described. Because of the simplicity of fructifications, there are few features of taxonomic value apart from spore and basidium characters. Host specificity is variable. Savile (1959) shows that two or more species of *Exobasidium* may infect a single host, which leads to confusion when the fungi are morphologically similar. Other species appear to be constantly host specific. Apart from recent work by Graafland (1960), with pure cultures of *E. vaccinii* and *E. japonicum,* few cross-inoculation experiments have been made.

Published by the Royal Society of New Zealand, c/o Victoria University of Wellington, P.O. Box 196, Wellington.

A number of species have been studied in pure culture (Graafland 1953, 1960, Gottgens 1960, Sundstrom 1960), but there appear to be few cultural characters of taxonomic importance. Sundstrom (1960) shows that the manner of basidiospore germination on agar substrates is constant in respect to the species investigated by him.

The host range of the genus is not known with certainty, but Savile (1959) records that members of the genus parasitise hosts in the Ericaceae, Empetraceae, Lauraceae, Symplocaceae and Theaceae. Of the eight species so far found in New Zealand, four are new, all occurring on members of the Epacridaceae. Apart from *E. antarcticum* Speg. on *Lebetanthus* from South America, which from the description appears to be only a conidial form, no *Exobasidium* has been previously recorded on the Epacridaceae. Of the four species described from overseas, three, *E. camelliae, E. gracilis* and *E. vaccinii* var. *japonicum*, occur on introduced hosts, while *E. gaultheriae* infects indigenous and endemic species.

ANATOMY OF THE INFECTION

In all species, with the exception of *E. novae-zealandiae* on *Cyathodes fasciculata*, there is a sharp distinction between diseased and healthy tissue. Where leaves are attacked, infected tissues show a lack of differentiation of the mesophyll accompanied by reduction in number and size of vascular strands. An increase in cell size and number indicates that both hyperplasy and hypertrophy occur. This situation has been described by a number of workers (Petri 1907, Wolf and Wolf 1952, Graafland 1960). A similar sequence occurs when stems or flowers are attacked.

The position of the hymenium varies. In *E. camelliae* and *E. gracilis*, the hymenium forms as an unspecialised stroma deep within the subepidermal tissue, ultimately causing the epidermis and its contiguous tissue to be cast off. In the remaining species, the hymenium forms immediately below the epidermis. Apart from an increase in number, epidermal cells are not affected and remain healthy until the cuticle is ruptured by the developing basidia. The epidermis is not cast off but remains as individual cells separated by the mature basidia.

The red-violet colouration often accompanying infection by *Exobasidium* species is due to the accumulation of anthocyanin pigment in the host tissue (Wolf & Wolf, 1952).

MATERIALS AND METHODS

Thin, hand-cut sections were used to study morphology of the infection, but these in general proved less satisfactory than scrape mounts (Savile 1959) for features of taxonomic importance. Where the hymenium is formed by a close palisade of basidia—e.g., *E. camelliae* and *E. gracilis*, sections were preferable.

As Savile (1959) points out, scrape mounts have the disadvantage of not yielding the full basidia length, but even in a section this is difficult to determine for no basal septum separates basidia from parent hyphae.

All specimens studied are in the Herbarium of the Plant Diseases Division, Auckland. Herbarium accession numbers are given after each specimen.

The writer wishes to thank Miss J. M. Dingley for her helpful advice, Professor W. R. Philipson, Botany Department, University of Canterbury, for bringing to his notice and collecting specimens of *E. fraserii*, and Professor L. W. A. Crawley, Classics Department, University of Auckland, for the Latin descriptions of four species.

Exobasidium Woronin, Ber. naturf. Ges. Freiburg i. B. 4: 397, 1867.

Host family specific, parasitic on leaves, shoots, stems or flowers of Dicotyledons, causing hypertrophy and deformation or not; mycelium intercellular, widespread, forming an unspecified stroma beneath the epidermis; hymenium on surface of

FIG. 1.—*Exobasidium dracophyllii* on shoots of *Dracophyllum uniflorum*, uninfected shoot in centre. FIG. 2.—*Exobasidium gaultheriae* on shoots of *Gaultheria rupestris*, uninfected shoot on right.

FIG. 1.—*Exobasidium camelliae* on flowering shoot of *Camellia japonica*. FIG. 2.—*Exobasidium vaccinii* var. *japonicum* on young leaves of *Rhododendron indicum*.

infected part, effuse or compact, composed of basidia; basidia simple, cylindrical to subclavate, projecting, bearing 2–8 spores on sterigmata; spores hyaline, smooth, simple or septate; germination by germ tube or conidia.

TYPE SPECIES. *Exobasidium vaccini* Woronin.

DISTRIBUTION. Cosmopolitan.

KEY TO SPECIES

1. Hymenium compact, basidia forming a palisade.
   2. Basidiospores 16.0–22.5 x 5.5–8.5μ ..... *E. camelliae* Shirai
   2. Basidiospores 12.5–16.0 x 3.5–5.5μ ..... *E. gracilis* (Shirai) Syd.
1. Hymenium effuse, basidia initially in fascicles or scattered.
   3. Basidia 2–(3) sterigmate, conidia absent, basidiospores mostly aseptate.
      4. Basidiospores 13.0–19.0 x 2.5–3.5μ, average 15.5 x 3.0μ ..... *E. pentachondrae* McNabb
      4. Basidiospores 16.0–27.0 x 3.5–8.0μ.
         5. Basidiospores 16.0–23.0 x 3.5–6.5μ, average 19.0 x 4.5μ ..... *E. fraserii* McNabb
         5. Basidiospores 20.0–27.0 x 5.0–8.0μ, average 23.5 x 6.5μ ..... *E. dracophyllii* McNabb
   3. Basidia (2)–4–(6) sterigmate, conidia present, basidiospores mostly 1-septate.
      6. Basidiospores strongly hooked at base, conidia 5.0–11.5μ long ..... *E. novae-zealandiae* McNabb
      6. Basidiospores not or moderately hooked at base.
         7. Basidia projecting 30–45μ beyond cuticle, conidia 5.0–10.0μ long, produced directly from both ends of basidiospore ..... *E. gaultheriae* Sawada
         7. Basidia projecting 30–70μ beyond cuticle, conidia 10.0–18.5μ long, produced on mycelium from germinating basidiospore ..... *E. vaccinii* var. *japonicum* (Shirai) McNabb

Exobasidium camelliae Shirai, Bot. Mag. Tokyo, 10; 51, 1896. (Text-fig. I, fig. 1. Plate 1, fig. 1.)

Attacking flower buds, occasionally flowering shoots; hymenium white, cerebriform, powdery at maturity, forming a continuous layer over surface of deformed organ, basidia closely packed, subclavate, 70–100μ long, 6–9μ wide; sterigmata 2, conical, 3.5–5.5μ long; basidiospores hyaline, smooth, cylindrical to subclavate, slightly or not hooked at base, 16.0–22.0 x 5.5–8.5μ, average 18.5 x 6.5μ, germinating spores (1)–3–4–(5)–septate, occasionally with one longitudinal septum; germination by germ tubes arising from each cell of spore; conidia abundant, hyaline, narrow fusiform, 9–11 x 1.5–2.5μ.

TYPE LOCALITY. Japan, on *Camellia japonica* L.

DISTRIBUTION. Japan, U.S.A., Great Britain, Europe, Australia, New Zealand.

HOST. *Camellia japonica* L.

Auckland: City, November 1953, M. J. Lockie, 12617; City, October 1956, unknown collector, 16671; Epsom, November 1958, H. Joyce, 18539; Mt Eden, October 1958, R.F.R.Mc., 19646; Tauranga, December 1960, P. Taylor, 19644; Remuera, October 1960, B. P. Coleman, 19645.

Both fungus and host are introduced species. *Exobasidium camelliae* generally attacks only flower buds, usually the innermost petals, causing hypertrophy and deformation of the parts, and often reducing the entire flower to a hollow, irregular mass up to 15 cms in length. In early stages of infection, the developing hymenium is covered by the epidermis and 3–8 layers of subepidermal tissue. As the hymenium

nears maturity, overlying layers are ruptured and remain attached to the mature, exposed hymenium as dry, brown, membranous scales.

Shirai (1896) describes spores of this species as oblong-obovate, 14.5–17.0 x 7μ, and basidia as 4-spored, but illustrations show basidia with 2, 3 and 4 sterigmata. The spore size of specimens examined is greater than that given by Shirai (1896), but as septation is not mentioned in this description, it seems probable that immature spores were measured. In all other respects New Zealand specimens agree closely with the original description.

Dennis and Wakefield (1946) describe an *Exobasidium* on *Camellia* flowers tentatively referred to *Exobasidium camelliae*. This fungus has two short, conical sterigmata, spores 1–3–septate at maturity, 15–18–(22) x 5.0–7.5μ, the majority about 18.0 x 7.0μ, and appears to be identical with the New Zealand fungus.

Characteristic features of this fungus are large, multi-septate spores, and the palisade of wide, bisterigmate basidia forming the hymenium.

Exobasidium gracilis (Shirai) Sydow. Ann. mycol. 10: 277, 1912. (Text-fig. I, fig. 2.)

Exobasidium camelliae var. *gracilis* Shirai, Bot. Mag. Tokyo, 10: 52, 1896.

Attacking only leaves; hymenium hypophyllous, white, cerebriform, powdery at maturity, forming a continuous layer over undersurface of leaf, occasionally spreading to upper surface, basidia closely packed, subclavate, 50–80μ long, 5.0–7.0μ wide; sterigmata 2–(4), conical, 3.0–4.0μ long; basidiospores hyaline, smooth, cylindrical to subclavate, slightly or not hooked at base, 12.5–16.0 x 3.5–5.5μ, average 13.5 x 4.0μ, germinating spores (1)–3–(5)–septate; conidia not seen.

TYPE LOCALITY. Japan, on *Camellia sasanqua* Thunb.

DISTRIBUTION. Japan, U.S.A., India, New Zealand.

HOST. *Camellia sasanqua* Thunb.

Auckland: Epsom, November 1957, H. M. Mouat, 18157.

Both fungus and host are introduced species. *Exobasidium gracilis* causes hypertrophy and deformation in young leaves which become inrolled to form hollow, irregularly-shaped structures. The immature hymenium develops as a layer in the mesophyll some 6–8 cells below the lower epidermis of the leaf. As basidia mature, the lower epidermis and its contiguous tissue are cast off, part remaining as thin, dry flakes, while the exposed basidia reach maturity on the new surface.

Apart from sterigmata number, the New Zealand specimen agrees closely with Shirai's (1896) original description. Both Shirai (1896) and Wolf and Wolf (1952) describe the basidia as 4-sterigmate. The differences in spore size and shape and basidia width and length are sufficient to uphold Sydow's (1912) separation of this species from *E. camelliae*. Although no cross-inoculations have been made between the two species and their hosts, both Shirai (1896) and Wolf & Wolf (1952) maintain that they are strictly host specific and that *E. gracilis* has never been seen to attack *Camellia japonica* or the flower buds of *C. sasanqua*.

Exobasidium gracilis is characterised by multi-septate spores and the palisade of basidia forming the hymenium, and may be separated from *E. camelliae* by narrower basidia and shorter, narrower spores.

Exobasidium pentachondrae n.sp. (Text-fig. I, fig. 4.)

Systemicum in surculis, efficiens hypertrophiam in frondibus et stirpibus infectis, hymenio albo, plerumque hypophyllio; basidia subclavata, 3–6-nario disposita, 25–35μ ultra cuticulam eminentia, 4.0–5.0μ lata; sterigmata 2, conica, 2.5–3.5μ longa; basidiosporae hyalinae, leves, cylindricae, tenuiter hamatae ad basim, 13.0–19.0 (15.5) x 2.5–3.5 (3.0)μ sporae germinantes 0–(4)–septatae; conidia absentia.

Systemic in shoots, causing hypertrophy in infected leaves and shoots; hymenium hypophyllous, white, basidia at first protruding between epidermal cells in fascicles of 3–6, forming a continuous layer over undersurface of leaf at maturity, subclavate,

projecting 25–35μ beyond cuticle, 4.0–5.0μ wide; sterigmata 2, conical, 2.5–3.5μ long; basidiospores hyaline, smooth, cylindrical, slightly hooked at base, 13.0–19.0 x 2.5–3.5μ, average 15.5 x 3.0μ, germinating spores 0–(4)–septate; conidia absent.

Distribution. New Zealand.

Host. *Pentachondra pumila* (J. R. & G. Forst.) R. Br. Otago, Fiordland, Secretary Island, February 1960, R.F.R.Mc., Type Collection P.D.D.Herb. No. 19669.

The host is an indigenous species occurring in the mountains of both islands and extending to Australia and Tasmania (Allan 1961, p. 514). Infection by *Exobasidium pentachondrae* causes shoots to become hypertrophied, elongated, and red-violet in colour.

E. pentachondrae is characterised by narrow, bisterigmate basidia and narrow cylindrical spores.

Exobasidium fraserii n.sp. (Text-fig. II, fig. 3.)

Systemicum, efficiens hypertrophiam in stirpibus infectis, hymenio albo, exiguo; basidia cylindrica vel subclavata, 3–6-nario disposita, 25–35μ ultra cuticulam eminentia, 4.5–6.5μ lata; sterigmata 2, conica 5–7μ longa; basidiosporae hyalinae, leves, cylindricae vel paene cylindricae, interdum modice hamatae ad basim, 16.0–23.0 (19.0) x 3.5–6.5 (4.5)μ, sporae germinantes aseptatae; conidia absentia.

Systemic, causing hypertrophy in infected stems; hymenium white, scanty, basidia at first protruding between epidermal cells in fascicles of 3–6, forming a semi-continuous layer over surface of stem at maturity, cylindrical to subclavate, projecting 25–35μ beyond cuticle, 4.5–6.5μ wide; sterigmata 2, conical, 5–7μ long; basidiospores hyaline, smooth, cylindrical or nearly so, occasionally moderately hooked at base, 16.0–23.0 x 3.5–6.5μ, average 19.0 x 4.5μ, germinating spores aseptate; conidia absent.

Distribution. New Zealand.

Host. *Cyathodes fraseri* (A. Cunn.) Allan.

Canterbury: Cass, May 1958, W. R. Philipson, Type Collection P.D.D. Herb. No. 19670.

C. fraseri is an endemic species occurring in both Islands (Allan 1961, p. 517). The symptom expression is an increase in the diameter of infected stems while leaves are not infected and remain unchanged.

Characteristic features of *Exobasidium fraserii* are long, cylindrical, aseptate basidiospores and bisterigmate basidia.

Exobasidium dracophyllii n.sp. (Text-fig. II, fig. 4. Plate 2, fig. 1.)

Systemicum in surculis, efficiens hypertrophiam in frondibus et stirpibus infectis, hymenio albo, plerumque hypophyllio; basidia cylindrica vel subclavata, 3–6-nario disposita, 25–45μ ultra cuticulam eminentia, 5.0–6.5μ lata; sterigmata 2–(3), conica, 6.0–8.5μ longa; basidiosporae hyalinae, leves, cylindricae vel tenuiter clavatae, basi non hamata, 20.0–27.0 (23.5) x 5.0–8.0 (6.5)μ, sporae germinantes 0–(1)–septatae; conidia absentia.

Systemic in shoots, causing hypertrophy in infected leaves and stems; hymenium hypophyllous, white, basidia at first protruding between epidermal cells in fascicles of 3–6, forming a continuous layer over undersurface of leaf at maturity, cylindrical to subclavate, projecting 25μ–45μ beyond cuticle, 5.0–6.5μ wide; sterigmata 2–(3), conical, 6.0–8.5μ long; basidiospores hyaline, smooth, cylindrical or slightly clavate, base not hooked, 20.0–27.0 x 5.0–8.0μ, average 23.5 x 6.5μ, germinating spores 0–(1)–septate; conidia absent.

Distribution. New Zealand.

Hosts. *Dracophyllum prostratum* Kirk.

Otago: Fiordland, Secretary Island, February 1960, R.F.R.Mc., 19668.

Dracophyllum uniflorum Hook. f.

Otago: Fiordland, Secretary Island, February 1960, R.F.R.Mc., Type Collection P.D.D. Herb. No. 19664.

The hosts are endemic species confined to the mountains of the South Island and southern North Island (Allan 1961, p. 524, 526). In both species the infection is similar, causing hypertrophy in leaves, sheathing leaf bases and stems, accompanied by elongation of infected parts and a red-violet colouration.

Exobasidium dracophyllii is characterised by long, broad basidiospores and bisterigmate basidia.

Exobasidium novae-zealandiae n.sp. (Text-fig. II, fig. 2.)

Systemicum in surculis, efficiens hypertrophiam in frondibus infectis, hymenio albo, plerumque hypophyllio; basidia cylindrica vel subclavata, 3–6-nario disposita, 20–35μ ultra cuticulam eminentia, 3.5–8.5μ lata; sterigmata (2)–4–(6), conica, 3.0–5.5μ longa; basidiosporae hyalinae, leves, cylindricae, ad basim decrescentes, modice vel firme hamatae ad basim, 11.0–18.0 (14.5) x 2.5–4.0 (3.5)μ, sporae germinantes (0)–1–(2)–septatae; conidia abundantia, hyalinae, acicularia, 5.0–11.5 x 1.0–2.0μ.

Systemic in shoots, causing hypertrophy in infected leaves and shoots; hymenium hypophyllous, white, basidia at first protruding between epidermal cells in fascicles of 3–6, forming a continuous layer over undersurface of leaf at maturity, cylindrical to subclavate, projecting 20–35μ beyond cuticle, 3.5–8.5μ wide; sterigmata (2)–4–(6), conical, 3.5–5.5μ long; basidiospores hyaline, smooth, cylindrical, tapering towards base, moderately to strongly hooked, 11.0–18.0 x 2.5–4.0μ, average 14.5 x 3.5μ, germinating spores (0)–1–(2)–septate; conidia abundant, hyaline, acicular, 5.0–11.5 x 1.0–2.0μ.

DISTRIBUTION. New Zealand.

HOSTS. *Archeria traversii* Hook. f.

Westland: Otira, January 1956, J. M. Dingley, 19663.
Cyathodes fasciculata (Forst. f.) Allan
Auckland: Piha, October 1956, J. M. Dingley, 19660; Piha, November 1959, J. M. Dingley, Type Collection P.D.D. Herb. No. 19659; Piha, September 1960, R.F.R.Mc., 19661; Piha, October 1960, R.F.R.Mc., 19662.

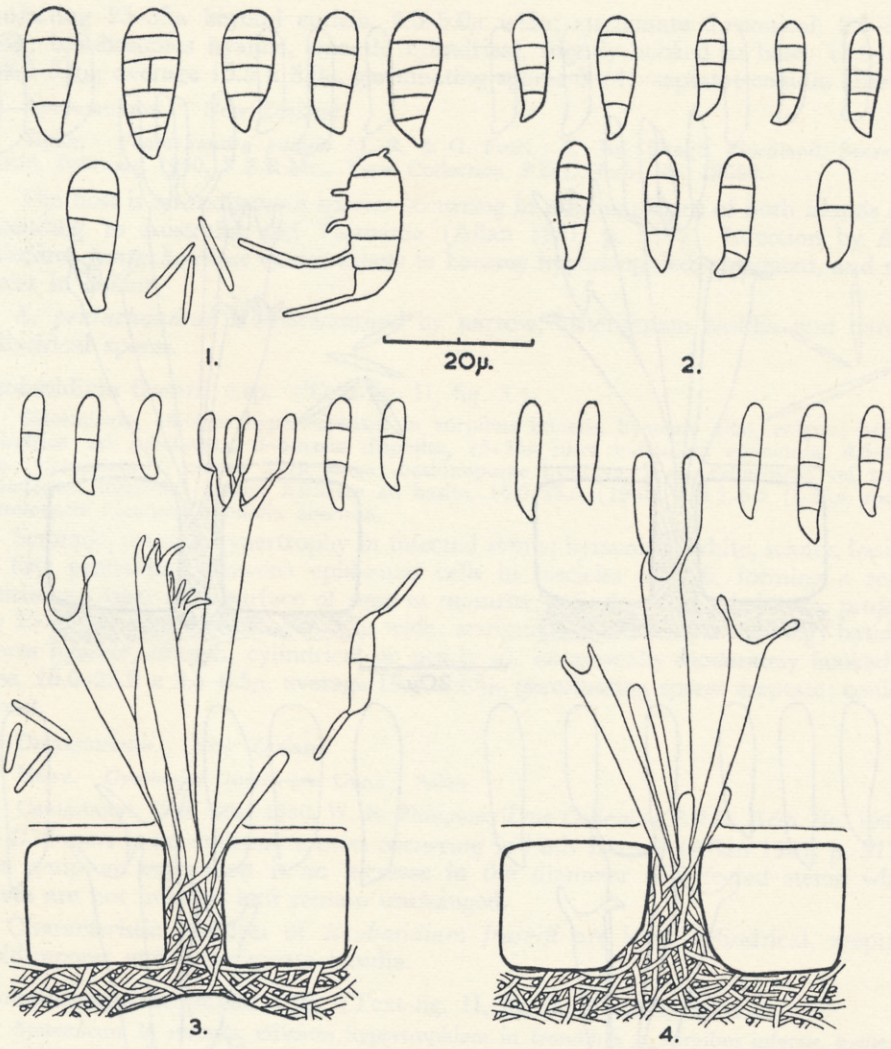
Archeria traversii and *Cyathodes fasciculata* are endemic species, the former confined to the South Island and the latter occurring throughout New Zealand (Allan 1961, p. 515, 519). Infected shoots on the type host become pale red but remain anatomically unchanged. On *Archeria traversii*, the fungus causes hypertrophy and elongation of infected shoots accompanied by a red colouration. The fungus on *A. traversii* differs from that on *Cyathodes fasciculata* in possessing narrower basidia and basidiospores, but because of the scarcity of collections on *Archeria traversii* it is not known whether these are constant differences.

Exobasidium novae-zealandiae is closely similar to *E. vaccinii* var. *japonicum* but the two may be separated by differences in basidiospore shape, and basidia and conidia length. *E. fraserii* on the allied species *Cyathodes fraseri* has bisterigmate basidia and larger spores as well as a different symptom expression.

Exobasidium novae-zealandiae is characterised by basidiospores with strongly hooked bases, usually 4 sterigmate basidia, and abundant conidia.

Exobasidium gaultheriae Sawada, Rept. Dept. Agr. Res. Inst. Formosa, 51: 63, 1931. (Text-fig. I, fig. 3. Plate 2, fig. 2.)

Systemic in shoots causing hypertrophy in infected leaves and shoots; hymenium hypophyllous, white, basidia at first protruding between epidermal cells in fascicles of 3–6, forming a continuous layer over undersurface of leaf at maturity, cylindrical to subclavate, projecting 30–45μ beyond cuticle, 3.5–5.5μ wide; sterigmata (2)–4–(6), conical, 4.0–6.5μ long; basidiospores hyaline, smooth, nearly cylindrical, straight or slightly curved, mostly with a moderately hooked base, 10.0–15.0 x 2.5–3.5μ, average 12.5 x 3.3μ, germinating spores 1–(3)–septate; conidia abundant, hyaline, acicular, 5–10 x 1–2μ, produced successively at both ends of the basidiospore.



Text-fig. I.—Fig. 1—*Exobasidium camelliae* Shirai, Basidiospores and conidia. Fig. 2—*Exobasidium gracilis* (Shirai) Syd., Basidiospores. Fig. 3—*Exobasidium gaultheriae* Sawada, Basidia, basidiospores and conidia. Fig. 4—*Exobasidium pentachondrae* McNabb, Basidia and basidiospores.

Type Locality. Formosa, on *Gaultheria bornensis* Stapf.

Distribution. Formosa, Tasmania, New Zealand.

Hosts. *Gaultheria antipoda* Forst. f.

Canterbury: Arthur's Pass, April 1960, J. M. Dingley, 19647.

Otago: Lake Wilkie, January 1957, J. M. Dingley, 18364.

Wellington: Mt Ruapehu, February 1957, R. M. Close, 19648; Rangipo Desert, May 1959, A. Y. Richardson, 18905; Rangipo Desert, March 1961, A. Y. McNabb, 19649.

Gaultheria depressa Hook. f.

Canterbury: Arthur's Pass, January 1956, J. M. Dingley, 18368.

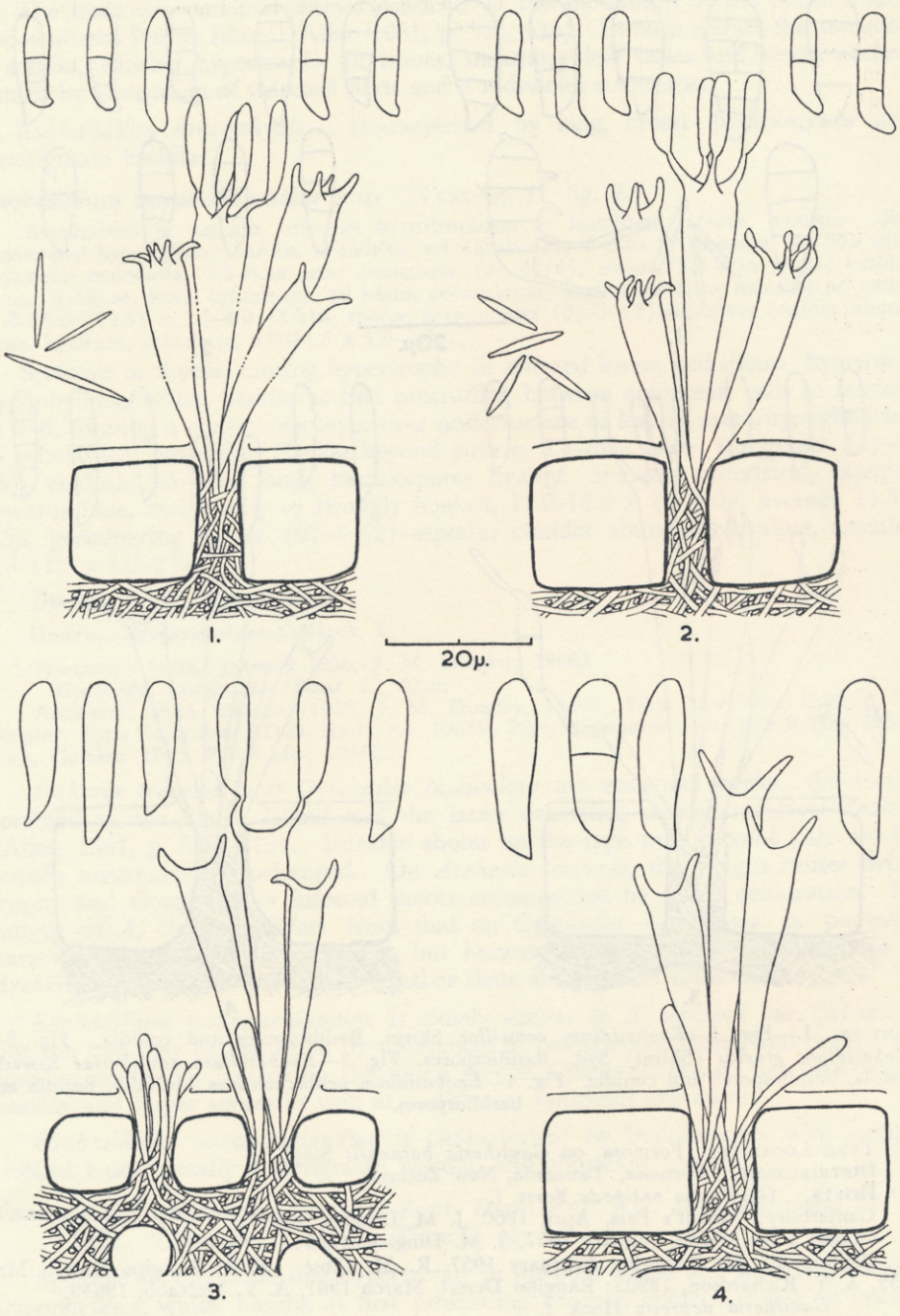
Taranaki: Mt Egmont, January 1953, J. M. Dingley, 18365.

Gaultheria rupestris (Linn. f.) D. Don.

Canterbury: Arthur's Pass, January 1956, J. M. Dingley, 18366; Arthur's Pass, April 1960, J. M. Dingley, 19651; Porter's Pass, February 1961, R.F.R.Mc., 19656.

Otago: Secretary Island, February 1960, R.F.R.Mc., 19650.

Gaultheria subcorymbosa Col.



TEXT-FIG. II.—Fig. 1—*Exobasidium vaccinii* var. *japonicum* (Shirai) McNabb, Basidia, basidiospores and conidia. Fig. 2—*Exobasidium novae-zealandiae* McNabb, Basidia, basidiospores and conidia. Fig. 3—*Exobasidium fraserii* McNabb, Basidia and basidiospores. Fig. 4—*Exobasidium dracophyllii* McNabb, Basidia and basidiospores.

Nelson: Karamea Bluff, October 1959, R.F.R.Mc., 19654; Karamea Bluff, December 1959, R.F.R.Mc., 19653; Karamea Track, February 1961, R.F.R.Mc., 19655.

G. depressa is an indigenous species occurring in Tasmania; the other hosts are endemic (Allan 1961, p. 506). Symptom expression is similar on all hosts, the fungus causing abnormal elongation and swelling of infected shoots accompanied by a red-violet colouration.

The New Zealand fungus agrees closely in all respects with Sawada's (1931) careful description.

Characteristic features of *E. gaultheriae* are narrow basidia and small, usually 1-septate basidiospores with hooked bases. *E. gaultheriae* has also been recorded from Tasmania on *Gaultheria hispida* by Petrak (1954).

Exobasidium vaccinii Woronin, var. **japonicum** (Shirai) n. comb. (Text-fig. II, fig. 1. Plate 1, fig. 2.)

Exobasidium japonicum Shirai, Bot. Mag. Tokyo, 10: 52, 1896.

Causing leaf galls; hymenium amphigenous, white, basidia at first protruding between epidermal cells in fascicles of 3–8, forming a continuous layer over surface of infected part at maturity, cylindrical to subclavate, projecting 30–70μ beyond cuticle, 6.0–8.5μ wide; sterigmata (2)–4–(6), conical, 3.5–5.0μ long; basidiospores hyaline, smooth, cylindrical or nearly so, slightly or moderately curved, mostly hooked at base, 11.0–17.0 x 2.5–4.5μ, average 15.0 x 3.5μ, germinating spores 1-septate; germination by germ tubes; conidia abundant, hyaline, acicular, 10.0–18.5 x 1.0–1.5μ.

Type Locality. Japan, on *Rhododendron indicum* Sweet.

Distribution. Japan, Europe, Argentina, New Zealand.

Host. *Rhododendron indicum* Sweet.

Auckland: Mangere, November 1951, K. A. J. Wise, 10969; Mt Eden, October 1959. R.F.R.Mc., 19657; Mt Eden, October 1960, R.F.R.Mc., 19658.
Canterbury: Christchurch, October 1952, I. L. Baumgart, 11674.
Nelson: City, November 1958, H. Jafar, 18590.
Otago: Mosgiel, January 1957, A. G. Keatley, 17159.
Wellington: Palmerston North, October 1952, B. P. Coleman, 11616.

Both fungus and host are introduced species. The fungus attacks young leaves causing hypertrophy and distortion; diseased areas become enlarged and thickened, and the lamina distorted by irregular growth. The galls produced are at first pale green, but become powdery white when the fungus sporulates. The red colouration characteristic of many species is not apparent and the gall may include part or all of the leaf.

Despite the morphological similarity of the two species, Graafland (1960) considers these differences sufficient for specific differentiation, and places the *Rhododendron* fungus under *Exobasidium japonicum* on the assumption that two earlier named species, *E. azalea* and *E. discoideum*, both on deciduous species of *Rhododendron* in North America, will also prove to be physiologically specialised. *Exobasidium azalea* and *E. discoideum* are both placed by Savile (1959) in *E. vaccinii* var. *vaccinii*. After examination of type material, Savile (1959) finds that basidiospore measurements of both fungi are considerably smaller than those given in the descriptions, and can find no morphological basis for their separation from *E. vaccinii* var. *vaccinii*.

Although basidiospores of the New Zealand fungus are slightly larger than those of *E. vaccinii*, the two species are morphologically indistinguishable. As a species should have a morphological basis, the view is taken here that *E. japonicum* is a physiological race of *E. vaccinii* restricted to *Rhododendron indicum* and *R. obtusum*, and deserves only varietal rank. If cross-inoculated experiments show that *Exobasidium azalea* and *E. discoideum* are not host specific but can infect hosts such

as *Rhododendron indicum* and *R. obtusum*, one of these earlier names will take priority over the varietal epithet "*japonicum*".

Exobasidium vaccinii var. *japonicum* is characterised by long basidia with a variable number of sterigmata, and the abundant, long, conidia.

The New Zealand fungus agrees closely with the description and illustrations of *Exobasidium japonicum* on *Rhododendron indicum* from Japan (Shirai 1896). Pathogenicity experiments have been performed by Graafland (1960) with pure cultures of *Exobasidium japonicum* obtained from *Rhododendron obtusum* and a hybrid cultivar of *R. indicum* and *R. obtusum* var. *amoenum*. Graafland (1953, 1960) compared these cultures with material of *Exobasidium vaccinii* from *Vaccinium vitis-ideae*, and in a series of cross-inoculation experiments (1960) showed that the *Rhododendron* species are not attacked by *Exobasidium vaccinii* and conversely that *Vaccinium vitis-ideae* does not act as a host for *Exobasidium japonicum*. As well as pathogenicity differences, *E. vaccinii* and *E. japonicum* differ in cultural characters such as growth form and colour (Graafland 1953, 1960).

LITERATURE CITED

ALLAN, H. H., 1961. *Flora of New Zealand, Vol. I.* Government Printer, Wellington.

DENNIS, R. W. G., and WAKEFIELD, E. M., 1946. New or interesting British Fungi. *Trans. Brit. mycol. Soc.* 29: 141–166.

GOTTGENS, E., 1960. Untersuchungen uber die Entwicklung von *Exobasidium Azalea* Peck und seine Infektion der Wirtspflanzen unter besonderer Berucksichtigung der gallenbildeneden Wirkstoffe. *Phytopath. Z.* 38: 394–426.

GRAAFLAND, W. 1953. Four species of *Exobasidium* in pure culture. *Acta Bot. Neerl.* 1: 516–522.

——— 1960. The parasitism of *Exobasidium japonicum* Shir. on *Azalea. Acta Bot. Neerl.* 9: 347–379.

MARTIN, G. W., 1961. In *Dictionary of the Fungi, Ed. V.*, by G. C. Ainsworth, Commonwealth Mycological Institute, Kew.

PETRAK, F. VON., 1954. Beitrage zur Pilzflora Australiens. *Sydowia,* 8: 192–220.

PETRI, L., 1907. Observazioni sulle galle fogliari di *Azalea indica* prodotte dall' *Exobasidium discoideum* Ellis. *Ann. mycol.* 5: 341–347.

SAVILE, D. B. O., 1955. A Phylogeny of the Basidiomycetes. *Canad. J. Bot.* 33: 60–104.

——— 1959. Notes on *Exobasidium. Canad. J. Bot.* 37: 641-656.

SAWADA, K., 1931. Descriptive Catalogue of the Formosan Fungi, Part V. *Rep. Dep. Agric. Res. Inst., Formosa,* 51: 1–152.

SHIRAI, M., 1896. Descriptions of some new Japanese species of *Exobasidium. Bot. Mag., Tokyo.* 10: 51–53.

SUNDSTROM, K. R., 1960. Physiological and morphological studies of some species belonging to the genus *Exobasidium. Phytopath. Z.* 40: 213–217.

SYDOW, H., SYDOW, P., and BUTLER, E. J., 1912. Fungi Indiae orientalis, Part IV. *Ann. mycol.* 10: 243–280.

TALBOT, P. H. B., 1954. Micromorphology of the lower Hymenomycetes. *Bothalia* 6: 249–299.

VIENNOT-BOURGIN, G., 1949. *Les champignons parasites des plantes cultivees, Vol. II.* Masson, Paris.

WOLF, F. T., and WOLF, F. A., 1952. Pathology of *Camellia* leaves infected by *Exobasidium camelliae* var. *gracilis* Shirai. *Phytopathology* 42: 147–149.

MR R. F. R. MCNABB, M.SC.,
Plant Diseases Division,
D.S.I.R.,
Private Bag, Auckland.